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Polyethylene Encapsulates for Hazardous Waste Drums

Environmental Protection Polymers, Inc.
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16. ABSTRACT

This capsule report summarizes studies of the use of polyethylene (P.E.) for encapsulating drums of hazardous wastes. Flat PE sheet is welded to roto moded PE containers which forms the encapsulates. Plastic pipe welding art was used, but the prototype welding apparatus required construction. Welded seams were inspected by optical microscopy and found to be continuous and void-free.

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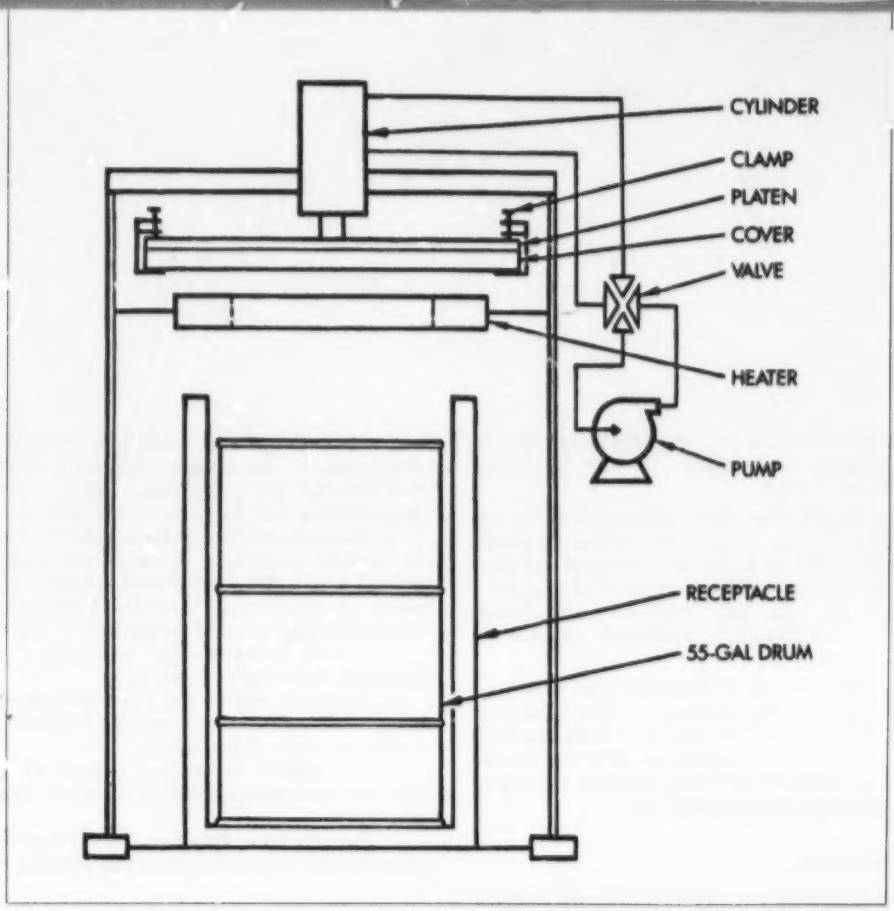

Figure 1. Drum-encapsulating apparatus.

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Polyethylene Encapsulates for Hazardous Waste Drums

Optical micrographs indicate that the plastic welds are continuous, void-free structures that should exhibit the high strength properties of polyethylene.

S. L. Unger, H. R. Lubowitz, R. W. Telles, Environmental Protection Polymers, Inc., Hawthorne, Calif. 90250 and
C. C. Wiles, U. S. Environmental Protection Agency, Cincinnati, Ohio 45268

To secure corroding 208-L (55-gal) drums holding hazardous wastes at the place where they reside, they were encapsulated in polyethylene (PE) overpacks on an "as-is" basis; i.e., no isolation of their contents was carried out. The encapsulated drums comply with Department of Transportation (DOT) specifications governing containers employed in transportation of hazardous wastes, and they are suitable for long-term, safe deposit in a landfill.

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The work was an outgrowth of previous work carried out under sponsorship of the Environmental Protection Agency (*1–3*). In previous work, hazardous, unconfined waste particulates, sludges and corroding small containers with contaminants were managed on a laboratory scale by encapsulating them in 63.5-mm (¼-in.) thick, seam-free PE jackets. So encased, the wastes were found to exhibit unusual resistance to delocalization under severe mechanical stresses and harsh leaching waters that simulated extreme case solutions that may be found in a landfill. When

management of 208-L (55-gal) drums was set forth, it was, therefore, proposed to encapsulate them also by jackets similar to those investigated.

Initial studies showed that encapsulating 208-L (55-gal) drums with PE jackets may be carried out best by plastic welding, involving particularly the art employed commercially for welding PE pipe (*4*). Fabricating PE encapsulates by welding, however, was not state-of-the-art. Consequently, commercial apparatuses applicable to such an operation did not exist.

With pipe welding art as a guideline, the prototype apparatus described here was constructed. The apparatus weld sealed PE receivers with PE flat sheet. Both receivers and flat sheet were items of commerce with the former being tailorable as required and being capable of production in commercial rotomolding operations.

Welding apparatus

The prototype apparatus was novel even though many of its features approximate features of commercial pipe welding apparatuses. It consisted of three major components; 1) the frame, 2) the hydraulic system, 3) the heater. The hydraulic system (pump, valves, cylinder, platen) and heater (with heater holder and circuitry) were attached to the frame. The apparatus was of modular construction; thus allowing easy replacement and interchanging of components and simplifying shipping, see Figure 1.

The apparatus was designed to be mobile and sturdy so that it could be used in field demonstrations of encapsulation. It can be refined for high-volume waste management operations. We visualize the refined apparatus to be similar to the prototype one, but modified with a light frame and microprocessors to control the hydraulic system.

The apparatus, in welding PE, was viewed as a hot melt sealing device. It was designed to alter the various parameters affecting the properties of the welded joint, i.e., heating and cooling times, temperature, welding pressure, etc.

In order to investigate the nature of the welded bond, the top portion of the welded encapsulate was removed. A close, visual inspection of the weld showed the formation of a continuous, solid, resinous bead surrounding the welded interface. The bead was approximately 0.95 cm (⅜ in.) thick. To investigate the watertightness of the welded bond, the specimen was charged with water containing a high-visibility dye which was detectable to 1 ppm. No leakage was observed over the three-month test period.

Several polyethylene receiver-cover welds were inspected by optical microscopy to determine the quality of the welded bonds. The optical micrographs suggested that the welds are continuous, void-free structures which should exhibit the high strength properties of polyethylene.

The work indicated that corroding 55-drums can be managed in the field as follows:

1. Transport welding apparatus and materials (materials can also be in the form of partially fabricated encapsulates) to the site where drums reside.
2. Encapsulate drums and transfer them to a landfill (encapsulates secure contents in case of mishaps in transportation).
3. Charge encapsulates into landfill according to accepted practice with respect to depositing containerized wastes.

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Unger

Lubowitz

Telles

Wiles